CENTRAL CALIFORNIA AIR QUALITY RESEARCH

What are the sources of particulate matter?

What does the science tell us about potential control strategies?

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California Air Resources Board
May 17, 2006

Introduction

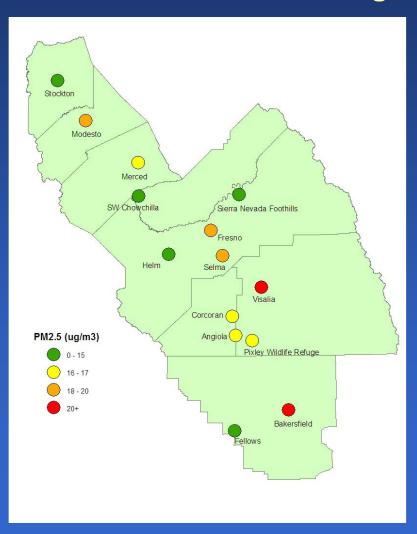
- How has the study improved our understanding of:
 - Sources of PM and how they vary by location and season
 - Effective controls for reducing PM concentrations throughout the region

PM Sources are Complex

- Includes both:
 - Sources that directly emit PM (primary PM)
 - Sources that emit gases that form PM through chemical conversions in the air (secondary PM)
- Regions are impacted by different combinations of sources
- The magnitude of different PM sources can vary throughout the year

PM Varies by Location

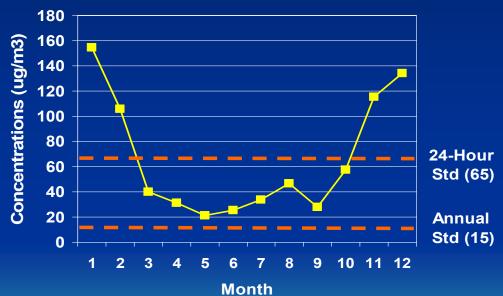
2000 PM2.5 Annual Average



- Concentrations above standards a concern throughout the Valley
- Concentrations generally highest in central and southern Valley
- Both urban and rural sites can exceed standards

PM Varies by Season

Monthly Average PM2.5 at Bakersfield



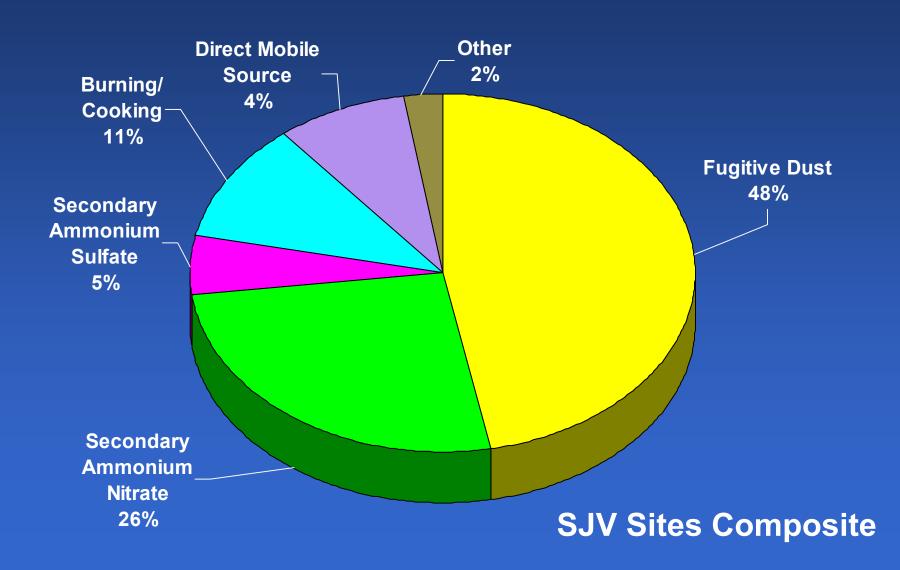
Turkiewicz et. al. 2005

- PM highest in fall and winter
- High 24-hour PM builds up over a period of several days to weeks (episode)
- Winter episodes occur during periods of stagnation with cool temperatures and high humidity

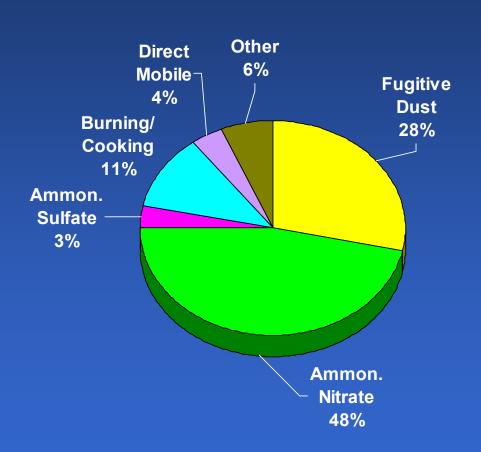
Linking Emissions Sources and Air Quality

- Measured PM dependant on several factors:
 - Emissions from sources
 - chemical and physical transformations
 - weather
- Air quality models link these factors to determine source contributions and evaluate the effectiveness of controls

Annual Average PM10 Source Contribution



Wintertime 24-hour PM10 Source Contributions



Burning/
Cooking
22% Ammon.
Sulfate
3%

Fugitive

Dust

Other

12%

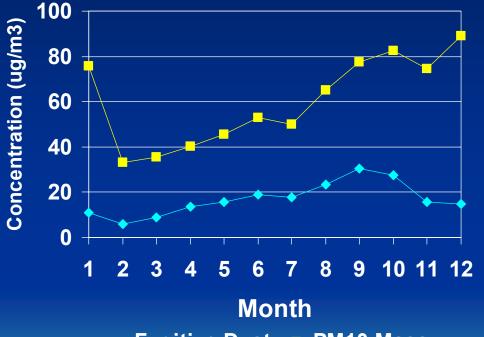
Direct

Bakersfield

Fresno

Fugitive Dust Controls

Seasonal Variation in Fugitive Dust Contribution to PM10



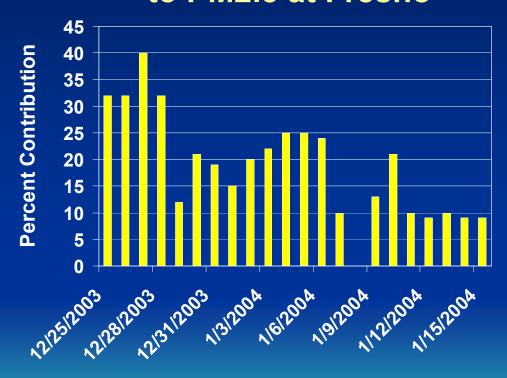
→ Fugitive Dust - PM10 Mass

Turkiewicz et. al. 2005

- Highest concentrations during the late summer/fall
- Large fraction of annual average PM10, but small contributor to PM2.5
- Can have significant local impacts
- Controls include:
 - Updated fugitive dust rule
 - Conservation management practices

Vegetative Burning Controls

Woodsmoke Contribution to PM2.5 at Fresno

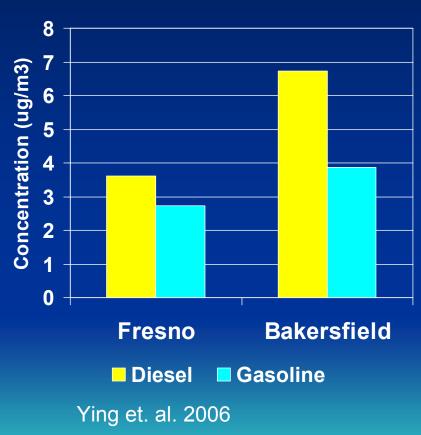


Gorin et. al. 2005

- Residential burning a significant contributor in the winter
- New markers for wood combustion helped identify impacts
- Controls include:
 - Residential wood combustion restrictions
 - Phase-out of agricultural burning
 - Smoke management program

Direct Mobile Source Controls

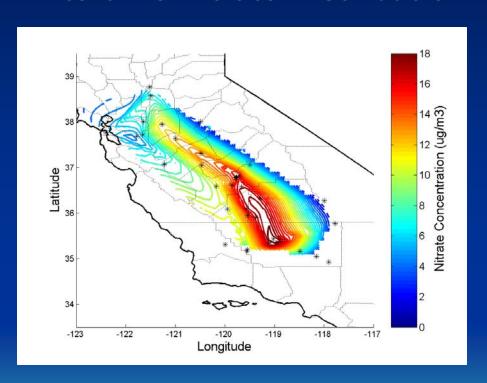
Direct Mobile Source Contributions to PM2.5



- Both gasoline and diesel sources are contributors
- Control programs include:
 - New vehicle emission standards
 - In-use Fleet Rules
 - Diesel Risk Reduction Program
 - Goods Movement ReductionPlan
 - Carl Moyer Program

Ammonium Nitrate Controls

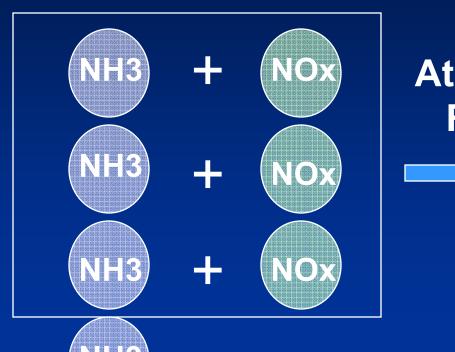
Wintertime Nitrate Distribution

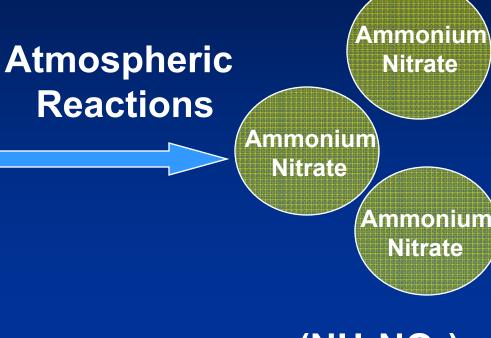


- Significant fraction of PM in the winter months
- High concentrations found in both urban and rural areas
- Extensive fog reduces concentrations
- Most effective control approach is reducing NOx emissions

Chow et. al. 2005

Ammonium Nitrate is Formed in the Atmosphere



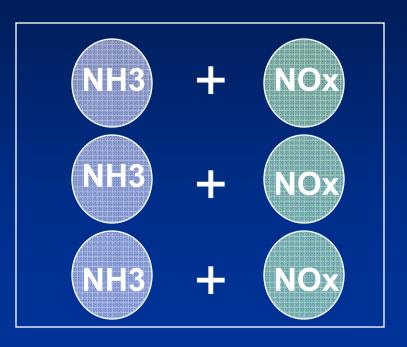


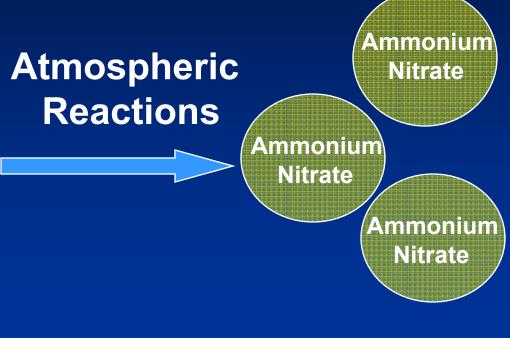
NH3

 (NH_4NO_3)

NH3

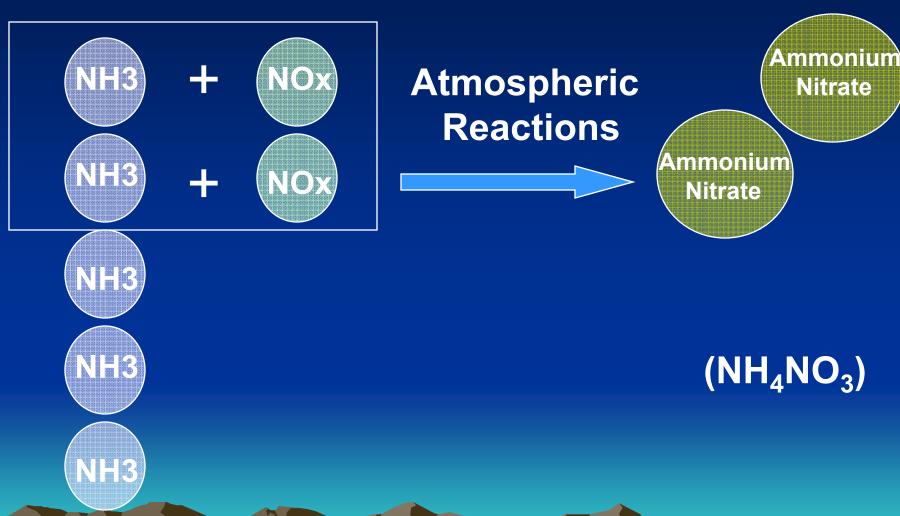
Reducing More Abundant Precursor Less Effective in Reducing Nitrate





 (NH_4NO_3)

Reducing Less Abundant Precursor More Effective in Reducing Nitrate

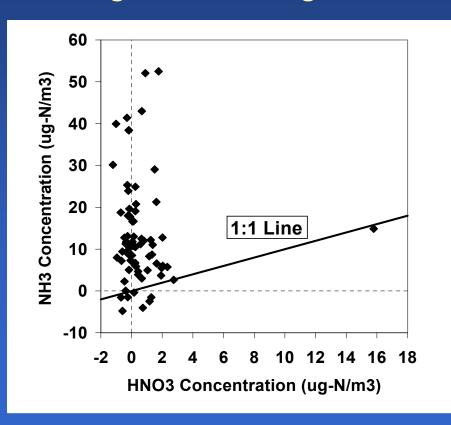


Multiple Methods to Evaluate Most Effective Precursor Control

- Evaluation of which precursor is most abundant: (qualitative)
 - Ammonia
 - Nitric acid (from NOx)
- "What-if" scenarios in air quality models: (quantitative)
 - Reduce ammonia by 50%
 - Reduce NOx by 50%

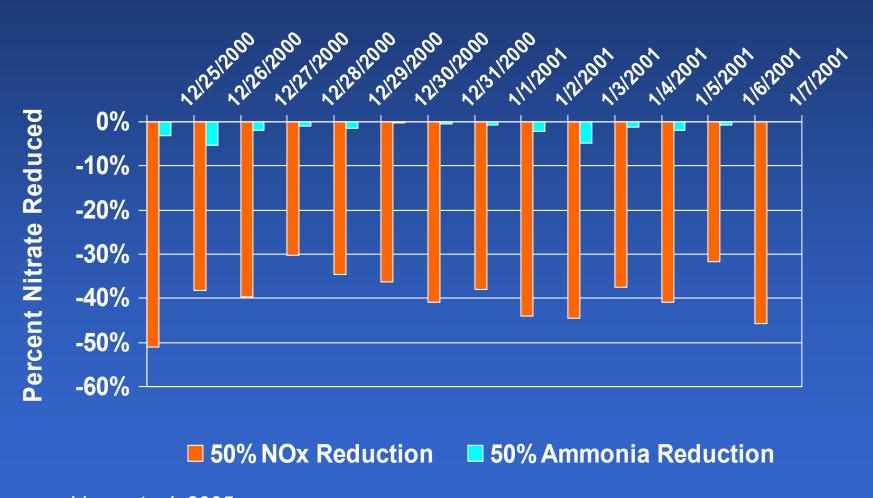
Ammonia is Much More Abundant than Nitric Acid

Angiola Monitoring Site



- Measured nitric acid (HNO3) concentrations are much *lower* than concentrations of ammonia (NH3)
- Reducing *least* abundant precursor is *most* effective for reducing ammonium nitrate

Reductions in NOx Much More Effective than Ammonia



Liang et. al. 2005

Conclusions and Next Steps

- Study results helped define needed controls for PM10 plan
- Study will continue to support upcoming PM2.5 planning efforts
- SJV is a continuing focus of research:
 - Fresno Asthmatic Children's Exposure Study
 - Fresno PM Supersite
 - San Joaquin Valley PM Health Effects Research Center